FM/IF amplifier/demodulator circuit — TDA1576T

FEATURES

- Fully balanced 4-stage limiting IF amplifier
- Symmetrical quadrature demodulator
- Field-strength indication output for 1 mA ammeter
- Detune detector for side response and noise attenuation
- Detune voltage output
- Internal muting circuit
- 0° and 180° AF output signals
- Reference voltage output
- Electronic smoothing of the supply voltage

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_P	supply voltage range (pin 1)	7.5	8.5	15	V
I_P	supply current	10	16	23	mA
V_{IF}	input sensivity (RMS value)				
	−3 dB before limiting	14	22	35	μV
	S/N = 26 dB	-	10	-	μV
	S/N = 46 dB	-	55	-	μV
V_{oAF}	AF output signal (RMS value)	-	67	-	mV
THD	total harmonic distortion with double resonant circuits	-	0.02	-	%
S/N	signal-to-noise ratio (V_i > 1 mV)	-	72	-	dB
α_{AM}	AM suppression	-	50	-	dB
RR	ripple rejection (f = 100 Hz)	43	48	-	dB
I_{15}	maximum indicator output current	-	-	2	mA
T_{amb}	operating ambient temperature	−30	-	+80	°C

GENERAL DESCRIPTION

The TDA1576T is a monolithic integrated FM-IF amplifier circuit for use in mono and stereo FM-receivers of car radios or home sets.

ORDERING AND PACKAGE INFORMATION

EXTENDED TYPE NUMBER	PACKAGE			
	PINS	PIN POSITION	MATERIAL	CODE
TDA1576T	20	mini-pack	plastic	SOT163A

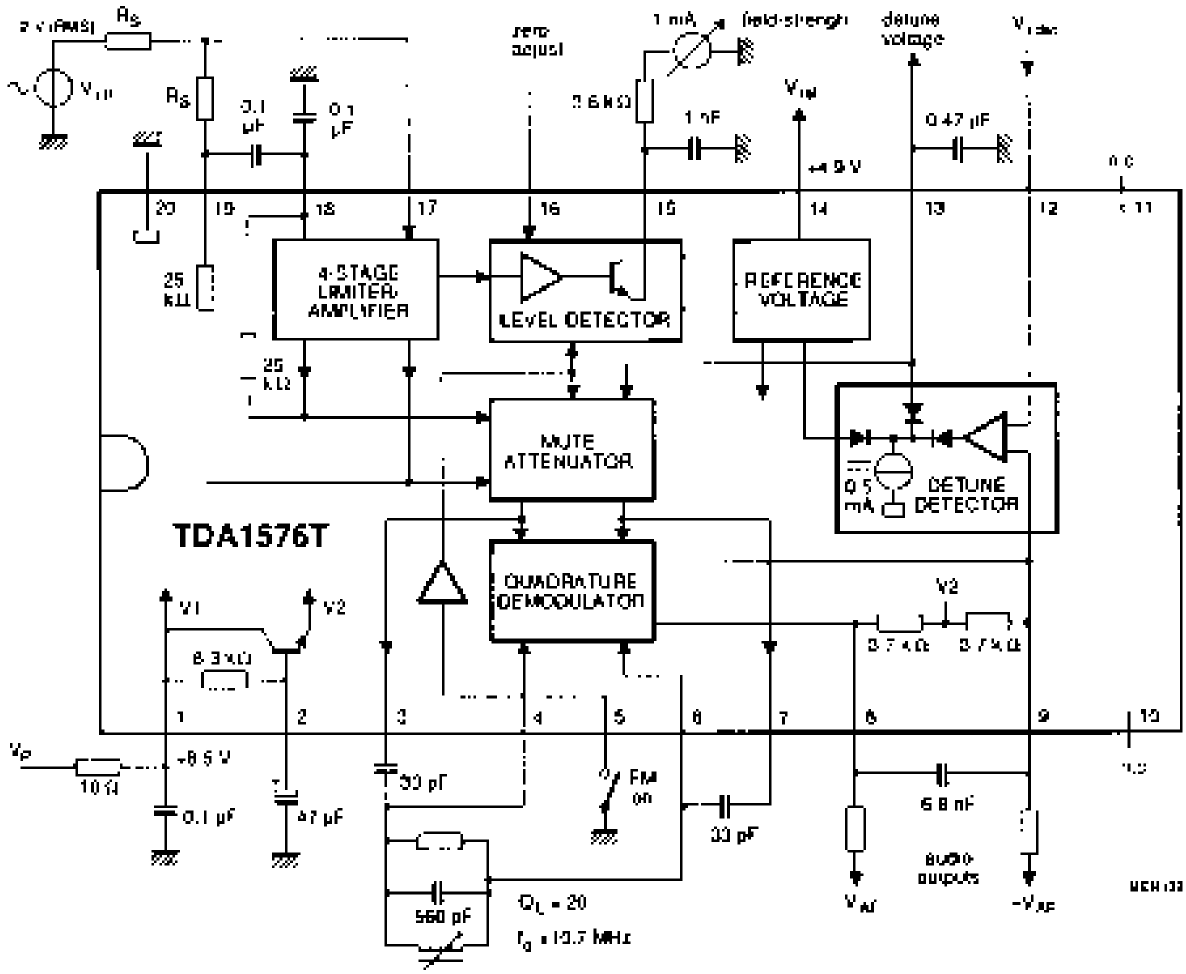


Fig.1 Block diagram and application circuit.

PINNING

SYMBOL	PIN	DESCRIPTION
V_P	1	positive supply voltage
C_{PS}	2	smoothing capacitor of power supply
IF1	3	IF signal to resonant circuit
RES1	4	resonant circuit
FMON	5	FM-ON, standby switch
RES2	6	resonant circuit
IF2	7	IF signal to resonant circuit
$V_{o\ AF1}$	8	AF output voltage (0° phase)
$V_{o\ AF2}$	9	AF output voltage (180° phase)
n.c.	10	not connected
n.c.	11	not connected
$V_{i\ det}$	12	detune detector input for external audio reference
$V_{o\ det}$	13	detune detector output voltage
V_{ref}	14	reference voltage output
V_F	15	level output for field-strength
V_{F0}	16	zero adjust for field-strength
$V_{i\ IF}$	17	FM-IF input signal
IN2	18	input 2 of differential IF amplifier
IFLV	19	IF input level
GND	20	ground (0 V)

PIN CONFIGURATION

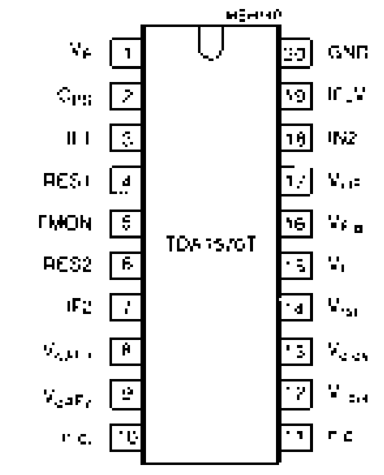


Fig.2 Pin configuration

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_P	supply voltage (pin 1)	0	15	V
$V_{2,\ 5,\ 16}$	voltage on pins 2, 5 and 16	0	V_P	V
P_{tot}	total power dissipation	0	450	mW
T_{stg}	storage temperature range	−55	150	°C
T_{amb}	operating ambient temperature range	−30	+85	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient in free air		85	K/W

CHARACTERISTICS

V_P = 8.5 V; $f_{i\,IF}$ = 10.7 MHz; R_S = 60 Ω; f_m = 400 Hz with Δf = ±22.5 kHz; 50 μs de-emphasis (C8-9 = 6.8 nF). T_{amb} = 25 °C and measurements taken in Fig.1, unless otherwise specified. The demodulator circuit is adjusted at minimum second harmonic distortion for $V_{i\,IF}$ = 1 mV and a deviation Δf = ±75 kHz.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_P	supply voltage range (pin 1)		7.5	8.5	15	V
I_P	supply current	$V_5 = V_9 = V_{13} = 0$	10	16	23	mA
Reference voltage						
V_{ref}	reference voltage (pin 14)	I_{14} = −1 mA	-	4.9	-	V
ΔV_{ref}	reference voltage dependence on temperature	$\Delta V_{14} / V_{14} \cdot \Delta T$	-	0.3	-	%/K
I_{14}	maximum output current	short-circuit current	4	6	7.5	mA
R_{14}	output resistor ($\Delta V_{14}/\Delta I_{14}$)	I_{14} < 1.2 mA	-	60	150	Ω
IF amplifier						
$V_{i\,IF}$	input sensivity (RMS value, pin 17)	−3 dB before limiting	14	22	35	μV
$R_{17\text{-}18}$	input resistance	$V_{i\,IF}$ = 200 mV (RMS)	10	-	-	kΩ
$C_{17\text{-}18}$	input capacitance	$V_{i\,IF}$ = 200 mV (RMS)	-	5	-	pF
$V_{o\,IF}$	output signal at pins 3 and 7 (peak-to-peak value)	$Z_{3,7}$ = 10 pF // 1MΩ	610	680	750	mV
$R_{3\text{-}7}$	output impedance		200	250	300	Ω
Demodulator						
$R_{4\text{-}6}$	input resistance		20	30	40	kΩ
$C_{4\text{-}6}$	input capacitance		-	1	2.5	pF
$R_{8\text{-}9}$	output impedance		2.9	3.7	4.5	kΩ
$V_{8,9}$	DC offset voltage on output pins at $V_{4\text{-}6}$ = 0	V_5 > 3 V or $V_{3,7}$ = 0 or V_{13} < 0.3 V	-	0	±100	mV
$\Delta V/\Delta\varphi$	demodulator efficiency	$\Delta V_{8\text{-}9}/\Delta\varphi$	-	40	-	mV/°
	demodulator efficiency dependent on supply voltage (note 1)	K		6.2	-	mV/°
V/V	DC voltage ratio	$V_8 + V_9 / 2 \cdot V_2$	0.653	0.667	0.680	V/V
$\Delta V/\Delta T$	dependence on temperature	$\Delta(V_8 + V_9 / 2 \cdot V_2)/\Delta T$	-	10^{-5}	-	1/K
Field-strength output						
V_{15}	output voltage (Fig.4)	$V_{i\,IF}$ = 0	0	0.1	0.25	V
		$V_{i\,IF}$ = 1 mV (RMS)	1.1	1.5	1.9	V
		$V_{i\,IF}$ = 250 mV (RMS)	3.2	3.6	4.1	V
S	control steepness	Fig.4	-	0.85	-	V/dec
R_{15}	output resistance		-	150	200	Ω
$\Delta V/\Delta T$	dependence on temperature	$V_{i\,IF} = \Delta V_{15}/(\Delta T \cdot V_{15})$	-	0.3	-	%/K
I_{15}	stand-by operational cut-off current	V_5 > 3 V; V_{15} = 0 to 5 V	-	-	10	μA

FM/IF amplifier/demodulator circuit TDA1576T

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero level adjustment						
V_{16}	internal bias voltage		-	260	-	mV
R_{16}	input resistance		-	19	-	kΩ
S	control steepness	$V_{i\ IF}$ = 100 mV; $A = \Delta V_{15} / \Delta V_{16}$	0.87	1.0	1.2	V/V
Detuning detector						
I_{12}	input bias current		-	20	100	nA
R_{12}	input resistance (Fig.5)	5 V/ΔI_{12}	6	30	-	MΩ
V_{13}/V_{14}	output voltage ratio for $\Delta\varphi = \varphi$ (pins 3-7) – φ (pins 4-6) –90°. (Fig.6)	$V_1 = V_2$ = 7.5 V; R_{13-14} = 10 kΩ; pins 9 and 12 short-circuit				
	$\Delta\varphi$ = 9.2° (43 kHz), Q = 20	$V_{9,\ 12}$ = 334 mV	0.45	0.5	0.55	V/V
	$\Delta\varphi$ = 3.5° (16 kHz), Q = 20	$V_{9,\ 12}$ = 138 mV	0.75	0.8	0.85	V/V
	$\Delta\varphi$ = 14° (65 kHz), Q = 20	$V_{9,\ 12}$ = 501 mV	0.335	0.345	0.356	V/V
I_{13}	maximum output current (Fig.7)	V_{13} = 6 V	0.4	0.5	0.6	mA
	cut-off current	V_{13} = 2.5 V; $V_{9,\ 12}$ = 0	-	-	–100	nA
Internal audio attenuation						
V_{13}/V_{14}	output voltage ratio (Fig.8)	α = attenuation factor				
	for α = 1 dB		0.11	0.12	0.13	
	for α = 7.2 dB		0.095	0.1	0.105	
	for $\alpha \geq$ 40 dB		-	0.06	-	
I_{13}	input current	$V_{13} / V_{13} \leq 0.1$	-	-	–225	nA
Stand-by switch						
V_5	input voltage for FM-on	$V_{3,\ 7} / V_{3,\ 7(max)}$ = 0.9	2.4	2.5	-	V
	input voltage for FM-off	V_{19} = 0.3 V	-	2.9	3	V
	linear range (Fig.9)		-	350	-	mV
I_5	input current	V_5 = 0 to 2 V	-	-	–100	μA
		V_5 = 3.5 to 15 V	-	-	1	μA
$V_5/\Delta T$	temperature dependence	FM-on (3.5V_{BE})	-	7	-	mV/K
		FM-off (5V_{BE})	-	10	-	mV/K
Supply voltage smoothing						
V_{1-2}	internal voltage drop	proportional to V_1 –3V_{BE}	80	210	400	mV
R_{1-2}	internal resistor		5.8	8.3	10.8	kΩ

OPERATING CHARACTERISTICS

V_P = 8.5 V; $f_{i\,ZF}$ = 10.7 MHz; R_S = 60 Ω; f_m = 400 Hz with Δf = ±22.5 kHz; 50 μs de-emphasis ($C_{8,9}$ = 6.8 nF); T_{amb} = 25 °C and measurements taken in Fig.1, unless otherwise specified. The demodulator circuit is adjusted at minimum second harmonic distortion with $V_{i\,ZF}$ = 1 mV

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
IF amplifier and demodulator						
$V_{i\,IF}$	input sensivity (RMS value, pin 17)	−3 dB before AF limiting	14	22	35	μV
	input signal for S/N = 26 dB	f = 250 to 15000 Hz	-	10	-	μV
	input signal for S/N = 46 dB	f = 250 to 15000 Hz	-	55	-	μV
$V_{o\,AF}$	output signal at (RMS value, pins 8 and 9)		60	67	75	mV
$V_{o\,N}$	noise voltage for $V_{i\,IF}$ = 0 (RMS value, pins 8 and 9)	R_S = 300 Ω; f = 250 to 15000 Hz	-	900	-	μV
	weighted noise voltage according to	DIN 45405	-	2	-	mV
S/N	signal-to-noise ratio Fig.3 (pin 8 and 9)	$V_{i\,IF}$ = 1 mV (RMS)	-	72	-	dB
α_{AM}	AM suppression	$V_{i\,IF}$ = 0.5 to 200 mV; FM: 70 Hz, ±15 kHz; AM: 1 kHz, m = 30%		50	-	dB
α_{FM}	FM rejection for FM-off	$V_{i\,IF}$ = 500 mV, V_S = 3V	60	-	-	dB
ΔV_{8-9}	AFC shift in relation to minimum second harmonic distortion d_{2H}	$V_{i\,IF}$ = 0.03 to 500 mV	-	25	-	mV
	DC offset at second harmonic distortion	operating		0	±100	mV
		mute or FM-off	-	0	±50	mV
d_{3H}	distortion for third harmonic		-	0.65	-	%
RR	ripple rejection V_{ripple} = 200 mV on V_P	f = 100 Hz	43	48	-	dB

Note to the characteristics

1. V_{8-9} / 2m = ±(V_P − 3 V_{BE})

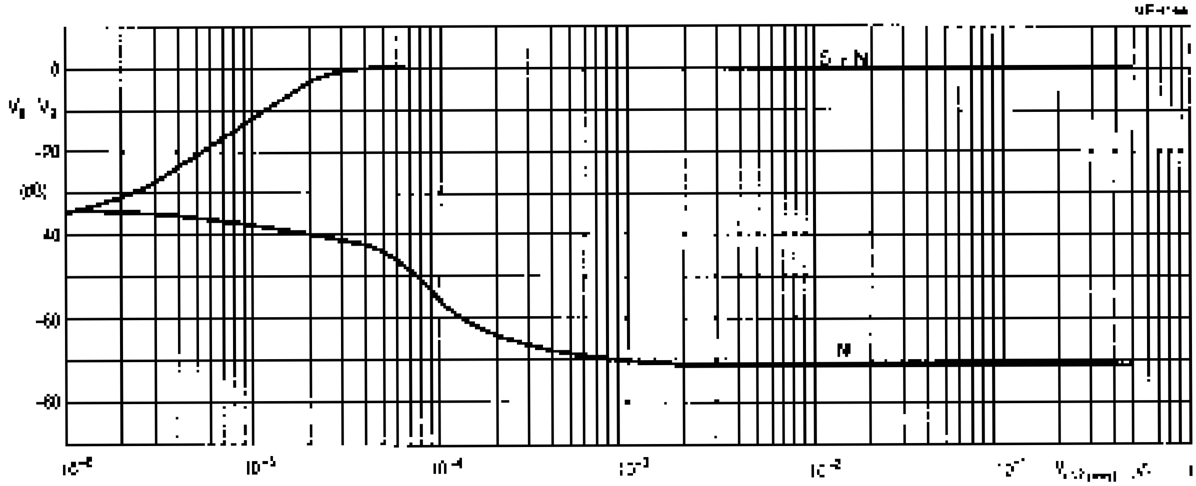


Fig.3 AF output voltage level on pins 8 and 9 as a function of $V_{i\ IF}$ at V_P = 8.5 V; f_m = 1 kHz; Q_L = 20 and with de-emphasis. S = signal; N = noise.

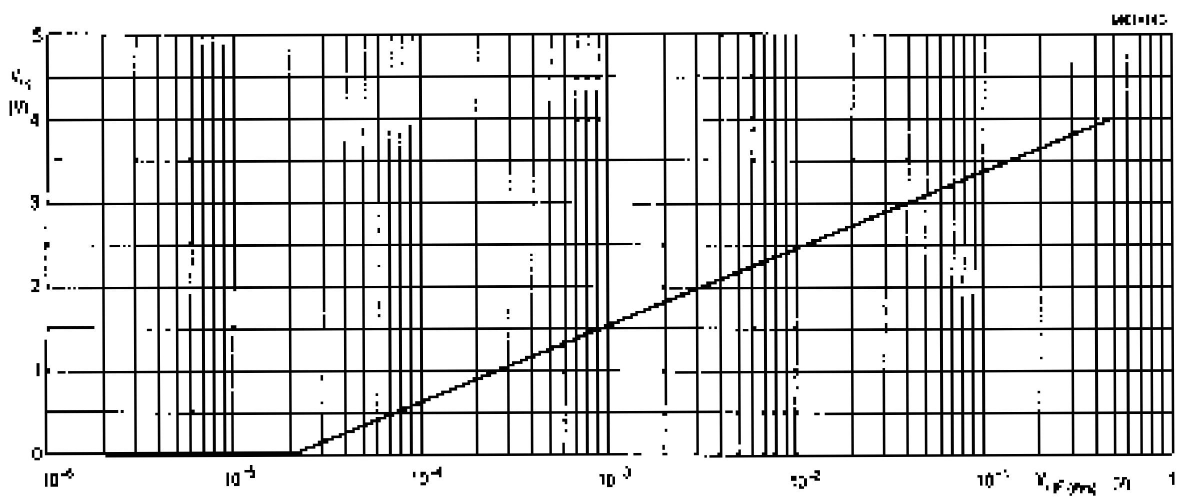


Fig.4 Field-strength output (I_{18} = 0).

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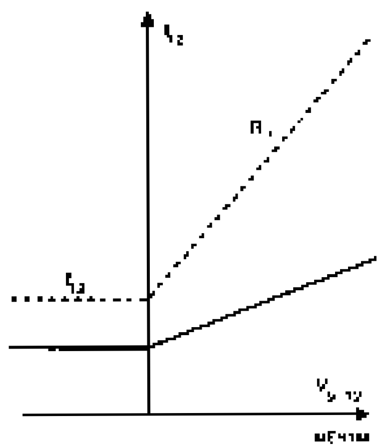


Fig.5 Detuning input impedance.

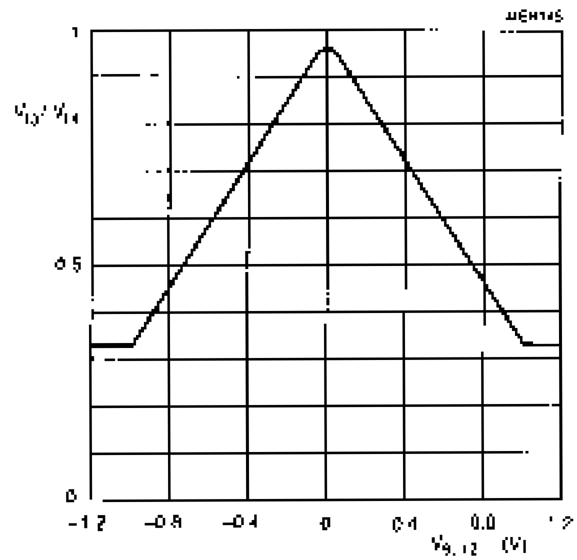


Fig.6 Detuning curve.

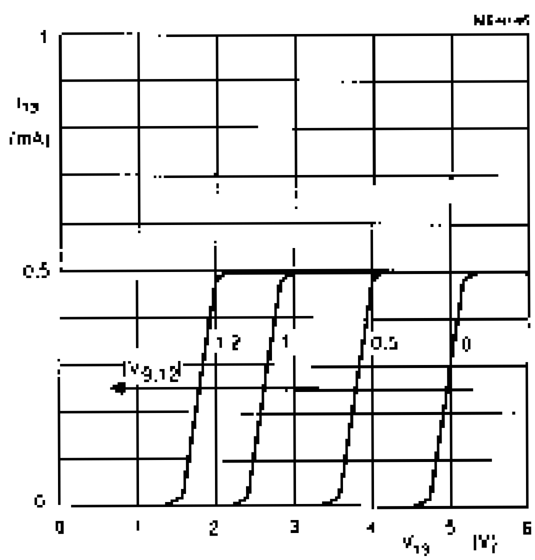


Fig.7 Detuning output.

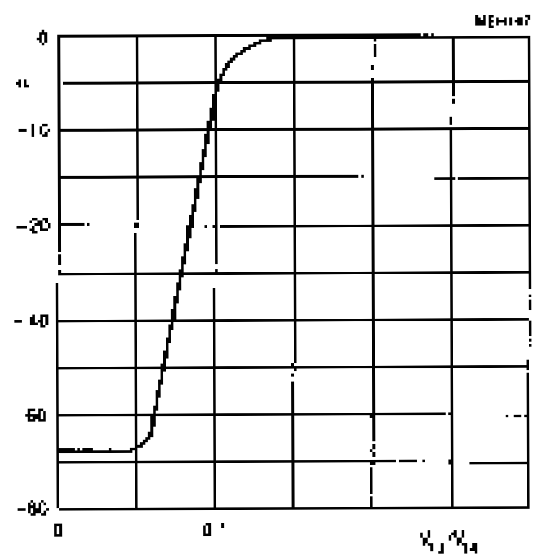


Fig.8 Internal audio attenuation.